

[0042] FIG. 9 is a timing chart which illustrates switching states of the switching elements and the electrical current which flows through the reactor under a situation where the electrical power converter operates in the second single operation mode and the vehicle is in the regeneration state.

[0043] Each of FIG. 10(a) and FIG. 10(b) is a circuit diagram which illustrates an electrical current path in the electrical power converter under the situation where the electrical power converter operates in the second single operation mode and the vehicle is in the regeneration state.

[0044] Each of FIG. 11(a) and FIG. 11(b) is a timing chart which illustrates the switching states of the switching elements of an electrical source system in a comparative example in which the switching states of two switching elements each of which is the upper arm or the lower arm are changed simultaneously.

[0045] FIG. 12 is a circuit diagram illustrating the circuit structure of the electrical power converter in the modified example.

[0046] Each of FIG. 13(a) and FIG. 13(b) is a table which illustrates the switching states of the switching elements in a first example of a modified operation in which the electrical power converter operates in the first single operation mode under a situation where a second relay is in the OFF state (moreover, a first relay is in the ON state) and the vehicle is in the power running state.

[0047] Each of FIG. 14(a) and FIG. 14(b) is a table which illustrates the switching states of the switching elements in a second example of the modified operation in which the electrical power converter operates in the first single operation mode under a situation where the second relay is in the OFF state (moreover, the first relay is in the ON state) and the vehicle is in the regeneration state.

[0048] Each of FIG. 15(a) and FIG. 15(b) is a table which illustrates the switching states of the switching elements in a third example of the modified operation in which the electrical power converter operates in the second single operation mode under a situation where the first relay is in the OFF state (moreover, the second relay is in the ON state) and the vehicle is in the power running state.

[0049] Each of FIG. 16(a) and FIG. 16(b) is a table which illustrates the switching states of the switching elements in a fourth example of the modified operation in which the electrical power converter operates in the second single operation mode under a situation where the first relay is in the OFF state (moreover, the second relay is in the ON state) and the vehicle is in the regeneration state.

[0050] FIG. 17 is a table which illustrates the switching states of the switching elements in a fifth example of the modified operation in which the electrical power converter operates in the first single operation mode under a situation where the second relay is in the ON state (moreover, the first relay is in the ON state) and the vehicle is in the power running state.

[0051] FIG. 18 is a table which illustrates the switching states of the switching elements in a sixth example of the modified operation in which the electrical power converter operates in the first single operation mode under a situation where the second relay is in the ON state (moreover, the first relay is in the ON state) and the vehicle is in the regeneration state.

[0052] FIG. 19 is a table which illustrates the switching states of the switching elements in a seventh example of the modified operation in which the electrical power converter

operates in the second single operation mode under a situation where the first relay is in the ON state (moreover, the second relay is in the ON state) and the vehicle is in the power running state.

[0053] FIG. 20 is a table which illustrates the switching states of the switching elements in a eighth example of the modified operation in which the electrical power converter operates in the second single operation mode under a situation where the first relay is in the ON state (moreover, the second relay is in the ON state) and the vehicle is in the regeneration state.

DESCRIPTION OF EMBODIMENTS

[0054] Hereinafter, an embodiment of the electrical source system of the present invention will be explained. Incidentally, in the following explanation, an embodiment in which the electrical source system of the present invention is applied to a vehicle (especially, a vehicle which moves (drives) by using an electrical power outputted from the electricity storage apparatus) will be explained. However, the electrical source system may be applied to any equipment other than the vehicle.

(1) Structure of Vehicle

[0055] Firstly, with reference to FIG. 1, the structure of the vehicle 1 of the present embodiment will be explained. FIG. 1 is a block diagram illustrating the structure of the vehicle 1 of the present embodiment.

[0056] As illustrated in FIG. 1, the vehicle 1 has a motor generator 10, an axle shaft 21, wheels 22 and an electrical source system 30.

[0057] The motor generator 10 operates by using an electrical power outputted from the electrical source system 30 to function as a motor for supplying a power (namely, a power which is required for the vehicle 1 to move) to the axle shaft 21 by, when the vehicle 1 is in a power running state. Furthermore, the motor generator 10 functions as a generator for charging a first electrical source 31 and a second electrical source 32 in the electrical source system 30, when the vehicle 1 is in a regeneration state.

[0058] Incidentally, the vehicle 1 may have two or more motor generators 10. Furthermore, the vehicle 1 may have an engine in addition to the motor generator 10.

[0059] The electrical source system 30 outputs the electrical power, which is required for the motor generator 10 to function as the motor, to the motor generator 10, when the vehicle 1 is in the power running state. Furthermore, the electrical power which is generated by the motor generator 10 functioning as the generator is inputted from the motor generator 10 to the electrical source system 30, when the vehicle 1 is in the regeneration state.

[0060] The electrical source system 30 has the first electrical source 31 which is one example of the “first electricity storage apparatus”, the second electrical source 32 which is one example of the “second electricity storage apparatus”, an electrical power converter 33, an inverter 35 and PCT (Power Control Unit) which is one example of the “control apparatus”.

[0061] Each of the first electrical source 31 and the second electrical source 32 is an electrical source which is capable of outputting the electrical power (namely, discharging). Each of the first electrical source 31 and the second electrical source 32 may be an electrical source to which the electrical